ties formed during the day. A few of the numbers may be given. In *Helianthus*, 9·64 grms. of starch disappeared in ten hours from one square metre of leaf-surface.

In the same plant 9·14 grms. were formed in the same time by the same area of leaf-surface.

In another case *Helianthus* was used, but the leaves were removed from the stem to prevent the passage back of the starch from the mesophyll into the stems.

A square metre was found to produce starch at the rate of 1·648 grms. per hour.

By combining his experimental results and taking note of all the circumstances, Sachs concludes that twenty to twenty-five grms. of starch per day may be produced by one square metre of leaf-surface as an ordinary occurrence; and these numbers are not only not excessive, but experiments show that there are plants which produce much more than those investigated here.

Some remarkably interesting and important results follow from the consideration of these experimental data.

They explain why plants are so vigorous during warm nights following upon hot bright days. The more readily the products of assimilation (formed in large quantities during the day) can pass into the growing organs, the better these are nourished, and so forth.

Leaves used for fodder, &c., must differ in nutritive value to a very great extent if their starchy contents vary so largely during the day and night: it thus becomes of primary importance whether such leaves are gathered in the morning or the evening, in cold or warm weather, &c. The same applies to *Tobacco* and *Tea*, &c. It must make a vast difference to the smoker whether his tobacco abounds in carbohydrates or is relatively richer in the alkaloids. It appears that tobacco is habitually cropped in the morning in some countries, a fact which suggests that experience has already shown that a difference in the quality exists; it will be interesting to inquire further into these matters.

Sachs's results will also materially affect the physiological value of the analyses of leaves. Some of us know how great are the variations met with in analyses of the ash contents of leaves of the same plant. It is clear that, in addition to the age of the leaf, the soil, manure, &c., it is important to know the amount of starch present. It cannot but happen that the mineral matters ebb and flow as well as the starch. The analyses of leaves will also be more valuable for the purposes of physiology if the numbers are stated, not in simple percentages, but in terms of one square metre of the leaf-surface.

The above brief summary of the results obtained by Prof. Sachs by no means does justice to the beauty of his methods, and the masterly way in which they were carried out: it must be admitted by all who understand the value and importance of this work that it is worthy of the great pioneer of vegetable physiology. Moreover, it suggests several matters which require further investigation, and would no doubt yield valuable results to those fortunate enough to have a botanical garden at hand.

H. MARSHALL WARD

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TELEPHONY AND TELEGRAPHY ON THE SAME WIRES SIMULTANEOUSLY

FOR the last eighteen months a system has been in active operation in Belgium whereby the ordinary telegraph wires are used to convey telephonic communications at the same time that they are being employed in their ordinary work of transmitting telegraphic messages. This system, the invention of M. Van Rysselberghe, whose previous devices for diminishing the evil effects of induction in the telephone service will be remembered, has lately been described in the *Journal Télégraphique* of Berne by M. J. Banneux of the Belgian Telegraph Department. Our information is derived from this article and from others by M. Hospitalier.

The method previously adopted by Van Rysselberghe, to prevent induction from taking place between the telegraph wires and those running parallel to them used for telephone work, was briefly as follows:—The system of sending the dots and dashes of the code—usually done by depressing and raising a key which suddenly turns on the current and then suddenly turns it off—was modified so that the current should rise gradually and fall gradually in its strength by the introduction of suitable resistances. These were introduced into the circuit at the moment of

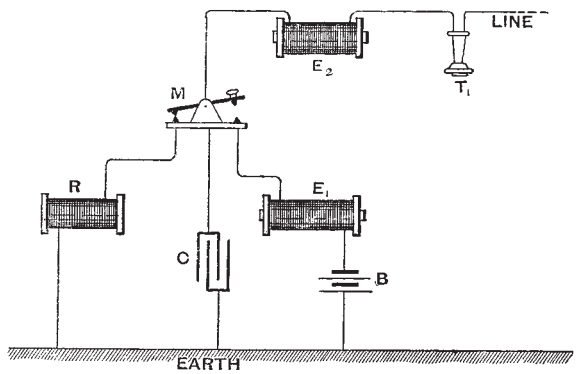

Fig. 1

closing or opening by a simple automatic arrangement worked exactly as before by a key. The result of the gradual opening and gradual closing of the circuit was that the current attained its full strength gradually instead of suddenly, and died away also gradually. And as induction from one wire to another depends not on the strength of the current, but on the rate at which the strength changes, this very simple modification had the effect of suppressing induction. Later Van Rysselberghe changed these arrangements for the still simpler device of introducing permanently into the circuit either condensers or else electromagnets having a high coefficient

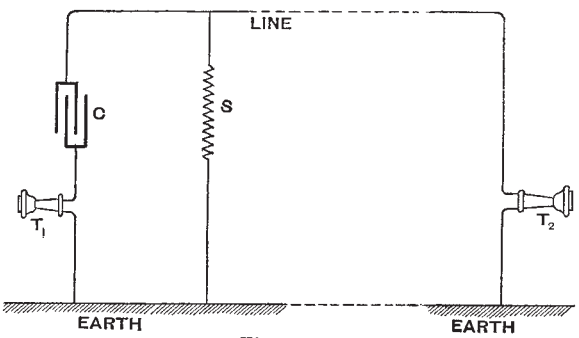

Fig. 2

of self-induction. These, as is well known to all telegraphic engineers, retard the rise or fall of an electric current; they fulfil the conditions required for the working of Van Rysselberghe's method better than any other device.

Having got thus far in his devices for destroying induction from one line to another, Van Rysselberghe saw that, as an immediate consequence, it might be concluded that, if the telegraphic currents were thus modified and graduated so that they produced no induction in a neighbouring telephone line, they would produce no sound in the telephone if that instrument were itself joined up in the telegraph line. And such was found to be the case

Why this is so will be more readily comprehended if it be remembered that a telephone is sensitive to the changes in the strength of the current if those changes occur with a frequency of some hundreds or in some cases thousands of times *per second*. On the other hand, currents vibrating with such rapidity as this are utterly incompetent to affect the moving parts of telegraphic instruments, which cannot at the most be worked so as to give more than 200 to 800 separate signals *per minute*.

The simplest arrangement for carrying out this method is shown in Fig. 1, which illustrates the arrangements at one end of a line. M is the Morse key for sending

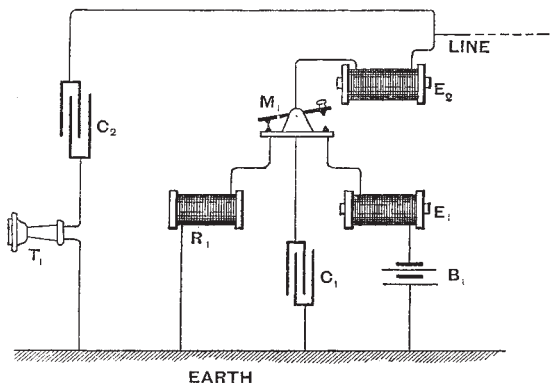

Fig. 3

messages, and is shown as in its position of rest for receiving. The currents arriving from the line pass first through a "graduating" electromagnet, E_2, of about 500 ohms resistance, then through the key, thence through the electromagnet R of the receiving Morse instrument, and so to the earth. A condenser, C, of 2 microfarads capacity is also introduced between the key and earth. There is a second "graduating" electromagnet, E_1, of 500 ohms resistance introduced between the sending battery B and the key. When the key M is depressed in order to send a signal, the current from the battery must charge the condenser C, and must magnetise the cores of the two electromagnets E_1 and E_2, and is thereby retarded in rising to its full strength. Consequently no sound is heard in a telephone, T, inserted in the line-circuit. Neither the currents which start from one end nor those which start from the other will affect the telephones inserted in the line. And, if these currents do not affect telephones in the actual line, it is clear that they will not affect telephones in neighbouring lines. Also the telephones so inserted in the main line might be used for speaking to one another, though the arrangement of the telephones in the same actual line would be inconvenient. Accordingly M. Van Rysselberghe has devised a further modification in which a separate branch taken from the telegraph line is made available for the telephone service. To understand this matter one other fact must be explained. Telephonic conversation can be carried on even though the actual metallic communication be severed by the insertion of a condenser. Indeed, in quite the early days of the Bell telephone, an operator in the States used a condenser in the telegraph line to enable him to talk through the wire. If a telephonic set at T_1 (Fig. 2) communicate through the line to a distant station, T_2, through a condenser, C, of a capacity of half a microfarad, conversation is still perfectly audible provided the telephonic system is one that acts by induction currents. And since in this case the interposition of the condenser prevents any continuous flow of current through the line, no perceptible weakening will be felt if a shunt, S, of as high a resistance as 500 ohms and of great electro-magnetic rigidity, that is to say, having a high coefficient of self-induction, be placed across the circuit from line to earth. In this, as well as in the other figures, the telephones indicated are of the Bell pattern, and if set up as shown in Fig. 2, without any battery, would be used both as transmitter and receiver on Bell's original plan. But as a matter of fact any ordinary telephone might be used. In practice the Bell telephone is not advantageous as a transmitter, and has been abandoned except for receiving; the Blake, Ader, or some other modification of the microphone being used in conjunction with a separate battery. To avoid complication in the drawings, however, the simplest case is taken. And it must be understood that instead of the single instrument shown at T_1 or T_2 a complete set of telephonic instruments in-

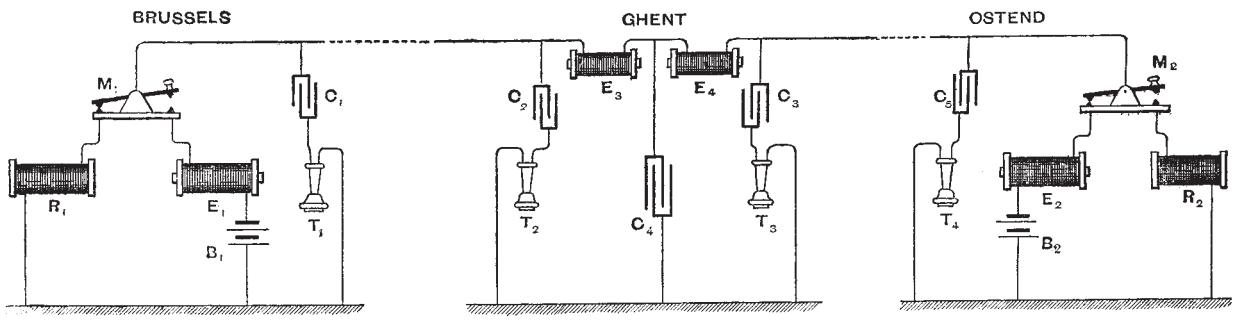

Fig. 4

cluding transmitter, battery, induction-coil, and receiver or receivers, may be substituted. And if a shunt, S, of 500 ohms placed across the circuit makes no difference to the talking in the telephones because of the interposition of the separating condenser C, it will readily be understood that a telegraphic system properly "graduated," and having also a resistance of 500 ohms, will not affect the telephones if interposed in the place of S. This arrangement is shown in Fig. 3, where the "graduated" telegraph-set from Fig. 1 is intercalated into the telephonic system of Fig. 2, so that both work simultaneously, but independently, through a single line. The combined system at each end of the line will then consist of the telephone-set T_1, the telegraph instruments (comprising battery B_1, key M_1, and Morse receiver R_1), the "graduating" electromagnets E_1 and E_2, the "graduating" condenser C_1, and the "separating" condenser C_2. It was found by actual experiments that the same arrangement was good for lines varying from 28 to 200 miles in length. A single wire between Brussels, Ghent, and Ostend is now regularly employed for transmission by telegraph of the ordinary messages and of the telemeteorographic signals between the two observatories at those places, and by telephone of verbal simultaneous correspondence

for one of the Ghent newspapers. A still more interesting arrangement is possible, and is indicated in Fig. 4. Here a separating condenser is introduced at the intermediate station at Ghent between earth and the line, which is thereby cut into two independent sections for telephonic purposes, whilst remaining for telegraphic purposes a single undivided line between Brussels and Ostend. Brussels can telegraph to Ostend, or Ostend to Brussels, and at the same time the wire can be used to telephone between Ghent and Ostend, or between Ghent and Brussels, or both sections may be simultaneously used.

It would appear then that M. Van Rysselberghe has made an advance of very extraordinary merit in devising these combinations. We have seen in recent years how duplex telegraphy superseded single working, only to be in turn superseded by the quadruplex system. Multiplex telegraphy of various kinds has been actively pursued, but chiefly on the other side of the Atlantic rather than in this country, where our fast-speed automatic system has proved quite adequate hitherto. Whether we shall see the adoption in the United Kingdom of Van Rysselberghe's system is, however, by no means certain. The essence of it consists in retarding the telegraphic signals to a degree quite incompatible with the fast-speed automatic transmission of telegraphic messages in which our Post Office system excels. We are not likely to spoil our telegraphic system for the sake of simultaneous telephony, unless there is something to be gained of much greater advantage than as yet appears.

NOTES

WE are pleased to be able to announce that Prof. Flower's title is to be "Director" of the Natural History Museum, South Kensington, not "Superintendent," as Prof. Owen was styled. According to the Civil Service Estimates for the present financial year his staff consists of four keepers of departments (Botany, Geology, Mineralogy, and Zoology), two assistant keepers (Geology and Zoology), eleven first-class assistants, and fourteen second-class assistants. Large as this number may seem, it is notorious that in the Zoological Department at least a considerable reinforcement is required before the work can be expected to be efficiently performed.

WE regret to learn from the *Times* that M. Dumas, the venerable *Secrétaire perpetuel* of the Academy of Sciences, is lying in a critical state at Cannes.

POPE LEO XIII. has erected at his own expense at Carpinetc-Romano, his native city, a meteorological observatory. It has been placed at the top of the castle of the Pecci family. The directorship of this establishment, which will be one of the most important in the whole Italian system, has been given to Count Lodovico.

WE are pleased to receive the first official publication issued from the Hong Kong Observatory by Dr. Doberck, giving the results of observations during the month of January. We are sure the establishment of this institution will be of the greatest service both to navigation and to science.

THE first International Ornithological Congress ever held was on Monday festively inaugurated at Vienna by its patron, the Crown Prince Rudolph—himself a noted ornithologist. In his opening speech, the Prince dwelt upon the great importance of those studies in natural history which characterise this century, a remark which was doubtless meant as a reply to the vehement attacks on modern science recently made by the Clerical Deputy Greuter in the Austrian Parliament. Germany and Austria have sent hither all their ornithological celebrities ; but the Congress also includes delegates from the Russian and French Governments, and members from Switzerland, Holland, and Sweden. Even Siam and Japan are represented, while England is conspicuous by her absence. The Congress began its deliberations with the question of International Protective Legislation for Birds.

THE sixth Archæological Congress will be held at Odessa from August 27 to September 1.

A SOMEWHAT novel feature in connection with the International Health Exhibition this year will be the establishment of a library and reading-room, a home for which the executive council have assigned in a large double room in the Albert Hall, overlooking the conservatory. Steps have been taken to secure a representative collection of works on vital statistics ; of reports and regulations relating to public health ; of regulations with reference to injurious trades and of works thereon ; and of reports, statistics, and other works on the science of education. Foreign powers have been invited to lend their cooperation in this effort to create an international library of works of reference bearing on the two divisions of the Exhibition, and several responses have already been received. India and the Colonies have also been asked to contribute towards the same end. Publishers and authors have likewise been invited to forward copies of their works. In addition to the library of reference, there will be a reading-room, to which the current numbers of periodical publications of a sanitary or educational character will be admitted. All books and periodicals sent to the library and reading-room will, under certain regulations, be arranged for the use of visitors, and not merely for exhibition. The books will be submitted to the jurors, and a full catalogue will be issued. All parcels for the library and reading-room should be addressed, carriage paid, to the Secretary of the Library Sub-Committee, Royal Albert Hall, London, S.W. The following handbooks are being written in connection with the Exhibition :—"Healthy Villages" (illustrated), by H. W. Acland, C.B., M.D., F.R.S. ; "Healthy Bed-Rooms and Nurseries, including the Lying-in Room," by Mrs. Gladstone ; "Healthy and Unhealthy Houses in Town and Country" (illustrated), by Mr. W. Eassie, C.E., with an appendix by Mr. Rogers Field, C.E. ; "Healthy Furniture and Decoration" (illustrated), by Mr. R. W. Edis, F.S.A. ; "Healthy Schools," by Mr. Charles Paget, M.R.C.S. ; "Health in Workshops," by Mr. J. B. Lakeman ; "Manual of Heating, Lighting, and Ventilation" (illustrated), by Capt. Douglas Galton, C.B., F.R.S. ; "Food," by Mr. A. W. Blyth, M.R.C.S. ; "Principles of Cookery," by Mr. Septimus Berdmore ; "Food and Cookery for Infants and Invalids," by Miss Wood, with a preface by R. B. Cheadle, M.D., F.R.C.P. ; "Drinks, Alcoholic," by John L. W. Thudichum, M.D., F.R.C.P. ; "Drinks, Non-Alcoholic and Aërated," by John Attfield, Ph.D., F.R.S. ; "Fruits of all Countries" (illustrated), by Mr. W. T. Thiselton Dyer, M.A., C.M.G. ; "Condiments, including Salt," by the Rev. J. J. Manley, M.A. ; "Legal Obligations in respect to Dwellings of the Poor," by Mr. Harry Duff, M.A., Barrister-at-Law, with a preface by Mr. Arthur Cohen, Q.C., M.P. ; "Moral Obligations of the Householder, including the Sanitary Care of his House," by G. V. Poore, M.D., F.R.C.P. ; "Laboratory Guide to Public Health Investigation" (illustrated), by W. W. Cheyne, F.R.C.S., and W. H. Corfield, M.D., F.R.C.P., M.A. ; "Physiology of Digestion and the Digestive Organs," by Prof. Arthur Gamgee, F.R.S. ; "Fermentation," by Dr. Duclaux, with a preface by M. Louis Pasteur, Membre de l'Institut ; "Spread of Infection," by Mr. Shirley F. Murphy ; "Fires and Fire Brigades" (illustrated), by Capt. Eyre M. Shaw, C.B. ; "Scavengering and other such Work in Large Cities," by Mr. Booth Scott ; "Athletics," Part I. (illustrated), by the Rev. E. Warre, M.A. ; "Athletics," Part II., by the Hon. E. Lyttleton, M.A., and Mr. Gerard F. Cobb, M.A. ; "Dress in relation to Health and Climate" (illustrated), by Mr. E. W. Godwin, F.S.A. ; "The